Appendix C. Source and Reliability of Estimates

SOURCE OF DATA

The data were collected during the fifth wave of the 1984 panel of the Survey of Income and Program Participation (SIPP). The SIPP universe is the noninstitutionalized resident population of persons living in the United States.[1] However, this report excludes information collected from the farm population and persons living in group quarters.

The 1984 panel SIPP sample is located in 174 areas comprising 450 counties (including one partial county) and independent cities. Within these areas, the bulk of the sample consisted of clusters of 2 to 4 living quarters (LQs), systematically selected from lists of addresses prepared for the 1970 decennial census. The sample was updated to reflect new construction.

Approximately 26,000 living quarters were designated for the sample. For Wave 1, interviews were obtained from the occupants of about 19,900 of the designated living quarters. Most of the remaining 6,100 living quarters were found to be vacant, demolished, converted to nonresidential use, or otherwise ineligible for the survey. However, approximately 1,000 of the 6,100 living quarters were not interviewed because the occupants refused to be interviewed, could not be found at home, were temporarily absent, or were otherwise unavailable. Thus, occupants of about 95 percent of all eligible living quarters participated in Wave 1 of the survey.

For the subsequent waves, only original sample persons (those interviewed in the first wave) and persons living with them were eligible to be interviewed. With certain restrictions, original sample persons were to be followed even if they moved to a new address. All noninterviewed households from Wave 1 were automatically designated as noninterviews for all subsequent waves. When original sample persons moved without leaving forwarding addresses or moved to extremely remote parts of the country, additional noninterviews resulted.

Noninterviews. Tabulations in this report were drawn from interviews conducted from January through April 1985. Table C-1 summarizes information on nonresponse for the interview months in which the data used to produce this report were collected.

[1]The noninstitutionalized resident population includes persons living in group quarter, such as dormitories, rooming houses, and religious group dwellings. Crew members of merchant vessels, Armed Forces personnel living in military barracks, and institutionalized persons, such as correctional facility inmates and nursing home residents, were not eligible to be in the survey. Also, United States citizens residing abroad were not eligible to be in the survey. With these qualifications, persons who were at least 15 years of age at the time of interview were eligible to be interviewed.

Table C-1. Sample Size by Month and Interview Status

Month	Eligible	Interviewed	Non-interviewed	Non-response rate (%)
January '85 . .	5,600	4,700	900	16*
February '85 . .	5,600	4,700	1,000	17
March '85** . .	4,600	3,800	800	18
April '85	4,700	3,800	900	18

*Due to rounding of all numbers at 100, there are some inconsistencies. The percentage was calculated using unrounded numbers.
**Starting in March 1985, a sample cut was implemented for budgetary reasons.

Some respondents do not respond to some of the questions. Therefore, the nonresponse rate for some items such as child care arrangements may differ from item to item. (See appendix D.)

Estimation. The estimation procedure used to derive SIPP person weights involved several stages of weight adjustments. In the first wave, each person received a base weight equal to the inverse of his/her probability of selection. For each subsequent interview, each person received a base weight that accounted for following movers.

A noninterview adjustment factor was applied to the weight of every occupant of interviewed households to account for households which were eligible for the sample but were not interviewed. (Individual nonresponse within partially interviewed households was treated with imputation. No special adjustment was made for noninterviews in group quarters.) A factor was applied to each interviewed person's weight to account for the SIPP sample areas not having the same population distribution as the strata from which they were selected.

An additional stage of adjustment to persons' weights was performed to bring the sample estimates into agreement with independent monthly estimates of the civilian (and some military) noninstitutional population of the United States by age, race, and sex. These independent estimates were based on statistics from the 1980 Census of Population; statistics on births, deaths, immigration, and emigration; and statistics on the strength of the Armed Forces. To increase accuracy, weights were further adjusted in such a manner that SIPP sample estimates would closely agree with special Current Population Survey (CPS) estimates by type of householder (married, single with relatives or single without relatives by

sex and race) and relationship to householder (spouse or other).[2] The estimation procedure for the data in the report also involved an adjustment so that the husband and wife of a household received the same weight.

RELIABILITY OF THE ESTIMATES

SIPP estimates in this report are based on a sample; they may differ somewhat from the figures that would have been obtained if a complete census had been taken using the same questionnaire, instructions, and enumerators. There are two types of errors possible in an estimate based on a sample survey: nonsampling and sampling. The magnitude of SIPP sampling error can be estimated, but this is not true of non-sampling error. Found below are descriptions of sources of SIPP nonsampling error, followed by a discussion of sampling error, its estimation, and its use in data analysis.

Nonsampling variability. Nonsampling errors can be attributed to many sources, e.g., inability to obtain information about all cases in the sample, definitional difficulties, differences in the interpretation of questions, inability or unwillingness on the part of the respondents to provide correct information, inability to recall information, errors made in collection such as in recording or coding the data, errors made in processing the data, errors made in estimating values for missing data, biases resulting from the differing recall periods caused by the rotation pattern and failure to represent all units within the universe (undercoverage). Quality control and edit procedures were used to reduce errors made by respondents, coders and interviewers.

Undercoverage in SIPP results from missed living quarters and missed persons within sample households. It is known that undercoverage varies with age, race, and sex. Generally, undercoverage is larger for males than for females and larger for Blacks than for non-Blacks. Ratio estimation to independent age-race-sex population controls partially corrects for the bias due to survey undercoverage. However, biases exist in the estimates to the extent that persons in missed households or missed persons in interviewed households have different characteristics than the interviewed persons in the same age-race-sex group. Further, the independent population controls used have not been adjusted for undercoverage in the decennial census.

The Bureau has used complex techniques to adjust the weights for nonresponse, but the success of these techniques in avoiding bias is unknown.

A bias may also occur in estimates related to unsupervised children. An example of such an estimate is total number of unsupervised children. The following causes for bias are suggested.

1. The complexity of the questions and concepts used to identify unsupervised children may have led to confusion among respondents.

2. In some jurisdictions the parents of children found to be "unsupervised" could be charged with the crime of "child neglect."

3. Respondents may fear they are placing a child in jeopardy by disclosing that the child is alone or unsupervised.

4. It may be more socially desirable to report that a child is supervised than that the child is not supervised.

The misreporting of any specific child care arrangement may affect the overall distribution of child care arrangements shown in this report. For example, an underestimate in the proportion of children being left without adult supervision would result in overestimates for one or more of the other child care arrangements.

Comparability with other statistics. Caution should be exercised when comparing data from this report with data from earlier SIPP publications or with data from other surveys. The comparability problems are caused by sources such as the seasonal patterns for many characteristics and different nonsampling errors.

Sampling variability. Standard errors indicate the magnitude of the sampling error. They also partially measure the effect of some nonsampling errors in response and enumeration, but do not measure any systematic biases in the data. The standard errors for the most part measure the variations that occurred by chance because a sample rather than the entire population was surveyed.

The sample estimate and its standard error enable one to construct confidence intervals, ranges that would include the average result of all possible samples with a known probability. For example, if all possible samples were selected, each of these being surveyed under essentially the same conditions and using the same sample design, and if an estimate and its standard error were calculated from each sample, then:

1. Approximately 68 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average result of all possible samples.

2. Approximately 90 percent of the intervals from 1.6 standard errors below the estimate to 1.6 standard errors above the estimate would include the average result of all possible samples.

3. Approximately 95 percent of the intervals from two standard errors below the estimate to two standard errors above the estimate would include the average result of all possible samples.

The average estimate derived from all possible samples is or is not contained in any particular computed interval. However, for a particular sample, one can say with a specified

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confidence that the average estimate derived from all possible samples is included in the confidence interval.

Standard errors may also be used for hypothesis testing, a procedure for distinguishing between population parameters using sample estimates. The most common types of hypotheses tested are 1) the population parameters are identical versus 2) they are different. Tests may be performed at various levels of significance, where a level of significance is the probability of concluding that the parameters are different when, in fact, they are identical.

All statements of comparison in the report have passed a hypothesis test at the 0.10 level of significance or better, and most have passed a hypothesis test at the 0.05 level of significance or better. This means that, for most differences cited in the report, the estimated absolute difference between parameters is greater than twice the standard error of the difference. If other differences have been mentioned, the estimated absolute difference between parameters is between 1.6 and 2.0 times the standard error of the difference. In such a case, the statement of comparison is qualified in some way (e.g., by use of the phrase "some evidence").

Note when using small estimates. Summary measures (such as medians and percent distributions) are shown in the report only when the base is 200,000 or greater. Because of the large standard errors involved, there is little chance that summary measures would reveal useful information when computed on a smaller base. Estimated numbers are shown, however, even though the relative standard errors of these numbers are larger than those for the corresponding percentages. These smaller estimates are provided primarily to permit such combinations of the categories as serve each user's needs. Also, care must be taken in the interpretation of small differences. For instance, in case of a borderline difference, even a small amount of nonsampling error can lead to a wrong decision about the hypotheses, thus distorting a seemingly valid hypothesis test.

Standard error parameters and tables and their use. To derive standard errors that would be applicable to a wide variety of statistics and could be prepared at a moderate cost, a number of approximations were required. Most of the SIPP statistics have greater variance than those obtained through a simple random sample of the same size because clusters of living quarters are sampled for SIPP. Two parameters (denoted "a" and "b") were developed to calculate variances for each type of characteristic.

The "a" and "b" parameters vary by subgroup. Table C-4 provides "a" and "b" parameters for characteristics of interest in this report. The "a" and "b" parameters may be used to directly calculate the standard error for estimated numbers and percentages. Because the actual variance behavior was not identical for all statistics within a group, the standard errors computed from parameters provide an indication of the order of magnitude of the standard error for any specific statistic.

For those users who wish further simplification, we have also provided general standard errors in tables C-2 and C-3. Note that these standard errors must be adjusted by an "f" factor from table C-4. The standard errors resulting from this simplified approach are less accurate. Methods for using these parameters and tables for computation of standard errors are given in the following sections.

Standard errors of estimated numbers. The approximate standard error, S_x, of an estimated number of persons shown in this report can be obtained in two ways. (Note that neither method should be applied to dollar values.)

It may be obtained by use of the formula

$$S_x = fs \qquad (1)$$

where f is the appropriate "f" factor from table C-4, and s is the standard error on the estimate obtained by interpolation from table C-2. Alternatively, Sx may be approximated by the formula

$$S_x = \sqrt{ax^2 + bx} \qquad (2)$$

from which the standard errors in table C-2 were calculated. Use of this formula will provide more accurate results than the use of formula 1 above. Here x is the size of the estimate and "a" and "b" are the parameters associated with the particular type of characteristic being estimated.

Illustration. SIPP estimates from text table G of this report show that 550,000 women with one child between 3 and 4 years old paid cash for child care arrangements. The appropriate "a" and "b" parameters and "f" factor from table C-4 and the appropriate general standard error from table C-2 are

a = -.0000669, b = 5,980, f = 0.52, s = 108,000

Using formula 1, the approximate standard error is

S_x = 0.52 x 108,000 ≈ 56,000

Table C-2. Standard Errors of Estimated Numbers of Persons

(Numbers in thousands)

Size of estimate	Standard error	Size of estimate	Standard error
200	66	50,000	923
300	81	80,000	1,066
600	114	100,000	1,110
1,000	147	130,000	1,111
2,000	208	135,000	1,103
5,000	326	150,000	1,068
8,000	410	160,000	1,032
11,000	477	180,000	927
13,000	516	200,000	760
15,000	552	210,000	639
17,000	585	220,000	469
22,000	658		
26,000	708		
30,000	753		

Table C-3. Standard Errors of Estimated Percentages of Persons

Base of estimated percentage (thousands)	Estimated percentage					
	1 or 99	2 or 98	5 or 95	10 or 90	25 or 75	50
200	3.3	4.6	7.2	9.9	14.3	16.5
300	2.7	3.8	5.9	8.1	11.7	13.5
600	1.9	2.7	4.1	5.7	8.2	9.5
1,000	1.5	2.1	3.2	4.4	6.4	7.4
2,000	1.0	1.5	2.3	3.1	4.5	5.2
5,000	0.7	0.9	1.4	2.0	2.9	3.3
8,000	0.5	0.7	1.1	1.6	2.3	2.6
11,000	0.4	0.6	1.0	1.3	1.9	2.2
13,000	0.4	0.6	0.9	1.2	1.8	2.0
17,000	0.36	0.5	0.8	1.1	1.5	1.8
22,000	0.31	0.4	0.7	0.9	1.4	1.6
26,000	0.29	0.4	0.6	0.9	1.3	1.4
30,000	0.27	0.4	0.6	0.8	1.2	1.3
50,000	0.21	0.3	0.5	0.6	0.9	1.0
80,000	0.16	0.2	0.4	0.5	0.7	0.8
100,000	0.15	0.2	0.3	0.4	0.6	0.7
130,000	0.13	0.18	0.3	0.4	0.6	0.6
220,000	0.10	0.14	0.2	0.3	0.4	0.5

Using formula 2, the approximate standard error is

$$\sqrt{(-.0000669)\,(550,000)^2 + (5,980)(550,000)} \approx 57,000$$

The 95-percent confidence interval as shown by the data is from 436,000 to 664,000. Therefore, a conclusion that the average estimate derived from all possible samples lies within a range computed in this way would be correct for roughly 95 percent of all samples.

Standard errors of estimated percentages. The reliability of an estimated percentage, computed using sample data for both numerator and denominator, depends upon both the size of the percentage and the size of the total upon which the percentage is based. When the numerator and denominator of the percentage have different parameters, use the parameter (and appropriate factor) of the numerator. If proportions are presented instead of percentages, note that the standard error of a proportion is equal to the quotient of the standard error of the corresponding percentage and 100.

For the percentage of persons, the approximate standard error, S(x,p), of the estimated percentage p can be obtained by the formula

$$S_{(x,p)} = fs \qquad (3)$$

In this formula, f is the appropriate "f" factor from table C-4 and s is the standard error on the estimate from table C-3. Alternatively, it may be approximated by the formula

$$S_{(x,p)} = \sqrt{(b/x)\,(p)\,(100-p)} \qquad (4)$$

from which the standard errors in table C-3 were calculated. Use of this formula will give more accurate results than use of formula 3 above. Here x is the size of the subclass of persons which is the base of the percentage, p is the percen-

tage (0 < p < 100), and b is the parameter associated with the characteristic in the numerator.

Illustration. Text table G shows that an estimated 23.8% of women with a single child between 3 and 4 years old who paid cash for child care arrangements paid at least $50.00 per week. Using formula 3 with the "f" factor from table C-4 and the appropriate standard error from table C-3, the appropriate standard error is

$$S_{(x,p)} = 0.52 \times 8.6\% = 4.5\%$$

Using formula 4 with the "b" parameter from table C-4, the approximate standard error is

$$S_{(x,p)} = \sqrt{\frac{5,980}{550,000}\,23.8\%(100\%-23.8\%)} = 4.4\%$$

Consequently, the 95-percent confidence interval as shown by these data is from 15.0 to 32.6 percent.

Standard error of a difference within this report. The standard error of a difference between two sample estimates is approximately equal to

$$S_{(x-y)} = \sqrt{S_x^2 + S_y^2} \qquad (5)$$

where S_x and S_y are the standard errors of the estimates x and y.

The estimates can be numbers, percents, ratios, etc. The above formula assumes that the sample correlation coefficient, r, between the two estimates is zero. If r is really positive (negative), then this assumption will lead to overestimates (underestimates) of the true standard error.

Illustration. Again using text table G, 32.1% of single child women who were employed full time and paid cash for child care arrangements paid at least $50.00 per week and 9.3% of those who worked part time paid at least $50.00 per week. The standard errors for these percentages are computed using formula 4, to be 3.1% and 3.7%. Assuming that these two estimates are not correlated, the standard error of the estimated difference of 22.7 percentage points is

$$S_{(x-y)} = (3.1\%)^2 + (3.7\%)^2 = 4.8\%$$

The 95-percent confidence interval is from 13.1 to 32.3 percentage points. Since this interval does not contain zero, we conclude that the difference is significant at the 5-percent level.

Standard error of a median. The median quantity of some item such as income for a given group of persons is that quantity such that at least half the group have as much or more and at least half the group have as much or less. The sampling variability of an estimated median depends upon the form of the distribution of the item as well as the size of the group. Standard errors on medians may be calculated by the procedure described below.

An approximate method for measuring the reliability of an estimated median is to determine a confidence interval about it. (See the section on sampling variability for a general discussion of confidence intervals.) The following procedure may

be used to estimate the 68-percent confidence limits and hence the standard error of a median based on sample data.

1. Determine, using either formula 3 or formula 4, the standard error of an estimate of 50 percent of the group;

2. Add to and subtract from 50 percent the standard error determined in step 1;

3. Using the distribution of the item within the group, calculate the quantity of the item such that the percent of the group owning more is equal to the smaller percentage found in step 2. This quantity will be the upper limit for the 68-percent confidence interval. In a similar fashion, calculate the quantity of the item such that the percent of the group owning more is equal to the larger percentage found in step 2. This quantity will be the lower limit for the 68-percent confidence interval;

4. Divide the difference between the two quantities determined in step 3 by two to obtain the standard error of the median.

To perform step 3, it will be necessary to interpolate. Different methods of interpolation may be used. The most common are simple linear interpolation and Pareto interpolation. The appropriateness of the method depends on the form of the distribution around the median. If density is declining in

Table C-4. SIPP Generalized Variance Parameters

Characteristic	a	b	f-factor
Total or White			
16 + program participation and benefits (3):			
Both sexes	-0.0001030	17,539	0.90
Male	-0.0002167	17,539	0.90
Female	-0.0001962	17,539	0.90
18 + welfare history and AFDC:			
Both sexes (2)	-0.0001026	17,539	0.90
Male	-0.0002162	17,539	0.90
Female	-0.0001952	17,539	0.90
16 + income and labor force[1] (4):			
Both sexes	-0.0000351	5,980	0.52
Male	-0.0000739	5,980	0.52
Female	-0.0000669	5,980	0.52
0-15 child care (5)	-0.0001155	5,980	0.52
All others[2] (6):			
Both sexes	-0.0000943	21,746	1.00
Male	-0.0001951	21,746	1.00
Female	-0.0001827	21,746	1.00
Black (1)			
Both sexes	-0.0002916	8,045	0.61
Male	-0.0006266	8,045	0.61
Female	-0.0005453	8,045	0.61

[1]Also use these parameters for tabulations of women by loss of work time from failure of child care arrangements and by cash payments made for child care.
[2]These parameters are to be used for all tabulations not specifically covered by any other category in this table.

Note: For cross tabulations for persons apply the parameters of the category showing the smaller number in parentheses.

the area, then we recommend Pareto interpolation. If density is fairly constant in the area, then we recommend linear interpolation. Note, however, that Pareto interpolation can never be used if the interval contains zero or negative measures of the item of interest. Interpolation is used as follows. The quantity of the item such that "p" percent own more is

$$\text{Pareto: } X_{pN} = \exp\left[\frac{Ln\ (p_N/N_1)}{Ln\ (N_2/N_1)}\right] Ln\ (A_2/A_1) \cdot A_1 \quad (6)$$

if Pareto Interpolation is indicated and

$$\text{Linear: } x_{pN} = \frac{pN - N_1}{N_2 - N_1}\ (A_2 - A_1) + A_1 \quad (7)$$

if linear interpolation is indicated, where N is the size of the group,

A1 and A2   are the lower and upper bounds, respectively, of the interval in which XpN falls,

N1 and N2   are the estimated number of group members owning more than A1 and A2, respectively,

exp   refers to the exponential function and

Ln   refers to the natural logarithm function.

Illustration. Again using text table G, the median weekly cash payment by employed mothers with one child less than 1 year old was $41.1. The size of this group was 263,000.

1. Using formula 4, the standard error of 50 percent on a base of 263,000 is about 7.5 percentage points.

2. Following step (2), the two percentages of interest are 42.5 and 57.5.

3. By examining text table G, we see that the percentage 42.5 falls in the interval from $40 to $49. (Since 51.8% pay more than $40 per month, but only 35.4% pay more than $50 per month, the quantity that exactly 42.5% pay

more than must be between $40 and $49.) Thus $A_1 = \$40, A_2 = \$49, N_1 = 136,000$, and $N_2 = 93,000$. In this case, we decided to use Pareto interpolation.

Therefore, the upper bound of a 68 confidence interval for the median is

$$\exp\left[\left(Ln\ \frac{(.425)\ (263,000)}{136,000} \middle/ Ln\ \frac{93,000}{136,000}\right) Ln\ \frac{49}{40}\right] (40)$$
$$= \$44.4$$

Also by examining text table G, we see that the percentage of 57.5 falls in the interval from $30 to $39. Thus, $A_1 = \$30, A_2 = \$39, N_1 = 192,000$, and $N_2 = 136,000$.- We also decided to use Pareto interpolation for this case. So the lower bound of a 68 confidence interval for the median is

$$\exp\left[\left(Ln\ \frac{(.575)\ (263,000)}{192,000} \middle/ Ln\ \frac{136,000}{192,000}\right) Ln\frac{39}{30}\right] (30)$$
$$= \$36.0$$

Thus, the 68-percent confidence interval on the estimated median is from $36.0 to $44.4. An approximate standard error is

$$\frac{\$44.4 - \$36.0 = \$4.2}{2}$$

Standard errors of ratios of medians. The standard error for a ratio of medians is approximated by:

$$S_{x/y} = \sqrt{\left(\frac{x}{y}\right)^2 \left[\left(\frac{S_y}{y}\right)^2 + \left(\frac{S_x}{x}\right)^2\right]} \quad (8)$$

where x and y are the medians, and sx and sy are their associated standard errors. Formula 8 assumes that the medians are not correlated. If the correlation between the two medians is actually positive (negative), then this procedure will provide an overestimate (underestimate) of the standard error for the ratio of medians.